NASA-CR-193334

University of Minnesota
Minneapolis, MN 55455

GRANT
7N-45-CR
176494
P. 3

INSTITUTE FOR MATHEMATICS AND ITS APPLICATIONS
FINAL REPORT TO NASA

(1) CONTRACT OR GRANT NUMBER: NASA/NAGW-3103

(2) PERIOD COVERED BY REPORT: 6/1/92–11/30/92

(3) TITLE OF PROPOSAL: Environmental Studies: Mathematical, Computational and Statistical Analyses

(4) NAME OF INSTITUTION: University of Minnesota, Minneapolis

(5) AUTHOR OF REPORT: Willard Miller, Jr.

As we enter the final decade of the twentieth century, environmental protection has become a universal issue with world-wide support. Destruction of the stratospheric ozone-layer, global increase in carbon dioxide and other radiatively important trace gases, acid rain, urban smog, water pollution of various types, and improper disposal of toxic wastes have all been shown as pressing problems for the 1990's. Environmental studies have now bridged the realms of academic research and societal applications. Mathematical modelling and large-scale data collection and analysis lie at the core of all environmental studies. Examples of such issues are the protection of the ozone-layer, climate change, regional and urban pollution, toxic waste disposal and water pollution. While each of these environmental problems involves extremely complex interplay of many physical, chemical and even human interactions, mathematical analysis serves as the single unifying foundation. Because of the well-recognized highly intensive and perturbing impact of direct environmental experiments, computational models become the prevalent tool in identifying, assessing and resolving these problems. Further, the physical scale and complexity of these problems demand an immense quantity of data which depends upon statistical analysis both in its gathering and its interpretation. Unfortunately, scientists, mathematicians, and engineers immersed in developing and applying environmental models, computational methods, statistical techniques and computational hardware advance with separate and often discordant paces.

The Summer Program on Mathematical, Computational and Statistical Analyses in Environmental Studies was designed to provide a much needed interdisciplinary forum for joint exploration of recent advances in the formulation and application of (A) environmental models, (B) environmental data and data assimilation, (C) stochastic modeling and optimization, and (D) Global climate modeling. These four conceptual frameworks provided common themes among a broad spectrum of specific technical topics at this workshop. The program brough forth a mix of physical concepts and processes such as chemical kinetics, atmospheric dynamics, cloud physics and dynamics, flow in porous media, remote sensing, climate statistics, stochastic processes, parameter identification, model performance evaluation, aerosol physics and chemistry, and data sampling together with mathematical concepts in stiff differential systems, advective-diffusive-reactive PDE's, inverse scattering theory, time series analysis, particle dynamics, stochastic equations, optimal control and others.

STRUCTURE

(I) The program consisted of four parts:

A. Week 1 and 2: Environmental models

B. Week 2 and 3: Environmental data and assimiliation

C. Weeks 3 and 4: Stochastic modeling and optimization.

D. Week 4: Global climlate modeling.

The overlap in each segment of the program was intended to increase interaction among scientists and mathematicians working in specified areas.

A proceedings on "Environmental Studies" will be published as two volumes in the series IMA Volumes in Mathematics and its Applications, Springer-Verlag. See preliminary Table of Contents below. Copies will be sent to NASA when they are available.

PRELIMINARY TABLE OF CONTENTS

(papers received to date)